

Analysis of cancer incidence data in eight ZIP code areas around Coldwater Creek, 1996-2011

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Summary

The Department of Health and Senior Services (DHSS) continues monitoring the burden of cancer in Missouri. The Cancer Inquiry Program responds to residents' concern about cancer excess in their communities in a systematic approach following the Missouri Cancer Inquiry protocol. The DHSS's efforts monitoring the incidence and mortality of cancers in the Coldwater Creek area extend back at least 25 years. The most recent past study published in 2013 analyzed the cancer incidence data in a six ZIP code (63031, 63033, 63034, 63042, 63134 and 63138) area adjacent to Coldwater Creek for the period 1996 through 2004. The report can be found at <http://health.mo.gov/living/healthcondiseases/chronic/cancerinquiry/reports.php#coldwater>.

This report updates the 2013 study by:

- Adding cancer incidence data from 2005 through 2011 so that years 1996-2011 were included in this analysis;
- Adding two ZIP codes (63043 and 63044) at the request of community members;
- Conducting a separate analysis for children age 17 or younger;
- Reporting data on some rare types of cancer (i.e., pharynx, salivary gland, appendix, renal pelvis, gall bladder, male breast, and intrahepatic bile duct) as separate categories; and
- Stratifying the leukemia cases by age and sex, and by different time periods.

The study found, compared to the expected number of cancer cases based on the rate for the rest of the state for the combined eight ZIP code area during 1996-2011:

- The observed number of incident cases of leukemia in the area was statistically significantly higher. The majority of excess leukemia cases were from ZIP codes 63031 and 63033, especially from:
 - Males age 65 or older in ZIP code 63031 during 2006-2011;
 - Males age 45-64 in ZIP code 63033 during 2006-2011; and
 - Females age 45-64 in ZIP code 63031 during 1996-2005.
- The observed number of incident cases of thyroid cancer in the area was statistically significantly lower.
- The observed number of female breast cancer cases in the area was statistically significantly higher.
- The observed number of colon, prostate, kidney cancers, and bladder cancer cases in the area was statistically significantly higher.
- The number of incident cases of brain and other nervous system cancer among children age 17 or younger was significantly higher than expected in ZIP code 63043 during 1996-2011.

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Background

Coldwater Creek is adjacent to several sites in the St. Louis, MO area which were involved in the processing and recovery of uranium during World War II. These sites were contaminated with radioactive waste as a result of those activities. Several other federal and state agencies are involved in ongoing environmental cleanup actions at these sites. The Missouri Department of Health and Senior Services (DHSS) will remain in a public health oversight role for ongoing environmental actions at these sites to assess public health concerns. While most of the radioactive wastes have been cleaned up, citizens have expressed concern that exposure to the wastes has increased the number of cancer cases in the area.

The DHSS continues monitoring the burden of cancer in Missouri. The Cancer Inquiry Program responds to residents' concern about cancer excess in their communities in a systematic approach following the Missouri Cancer Inquiry protocol. The DHSS's efforts of monitoring the incidence and mortality of cancers in the Coldwater Creek area extend back at least 25 years. In the most recent study published in 2013, it was found that the number of incident cases of breast, colon, prostate, and kidney and renal pelvis cancers in the six ZIP code Coldwater Creek area was significantly higher than expected, but the number of incident cases of cancers of oral cavity and pharynx, cervix uteri, and thyroid was significantly lower than expected based on the state rates for the period of 1996-2004. For detailed information on the 2013 study, please visit the DHSS website at:

<http://health.mo.gov/living/healthcondiseases/chronic/cancerinquiry/reports.php#coldwater>.

As additional years of cancer incidence data and the 2010 census data became available, the department updated the 2013 study by adding cancer data through the year 2011, adding two ZIP codes (63043 and 63044) at the request of community members, and conducting a separate analysis for children age 17 or younger, and stratifying leukemia cases by age and sex, and by different time periods. In addition, we also reported the data on some rare types of cancer (i.e., pharynx, salivary gland, appendix, renal pelvis, gall bladder, male breast, and intrahepatic bile duct) as separate categories.

Study Method

For this study, the area selected for analysis included the eight ZIP codes close to Coldwater Creek: 63031, 63033, 63034, 63042, 63043, 63044, 63134 and 63138 (See Figure 1). ZIP codes 63043 and 63044 were added based on the suggestions from community members. The observed number of cancer cases from each ZIP code and all eight ZIP codes combined were compared with the expected number based on the incidence rates for the rest of the state of Missouri (excluding the eight ZIP codes included in the study) for the period of 1996 through 2011. The analysis was completed using data based on the ZIP code where each person was living at the time of diagnosis. Information about where patients lived prior to their diagnoses was not available.

The observed number of cancer cases was calculated based on the data reported to the Missouri Cancer Registry (MCR). All patients diagnosed with cancer who lived in one of the eight ZIP codes at the time of diagnosis and were reported to MCR were included in the analysis. When

calculating the expected number of cases, the age-, gender-, and race-specific incidence rates for the selected cancers in the rest of the state of Missouri (excluding the eight ZIP codes included in this study) were applied to the study population of the corresponding demographic groups to obtain an expected number of cases for the study area (i.e., using the indirect method of rate standardization). The population numbers in the ZIP codes in the years 1996 through 2011 were estimated using the 2000 and 2010 census populations through a linear interpolation and extrapolation. Standardized incidence ratios (SIRs), the ratios of the observed to expected numbers of incident cancers, were calculated. Ninety-five percent confidence intervals (CIs) for the SIRs were computed by assuming the observed number to be distributed as a Poisson variable¹. A 95% CI that contains 1.0 indicates that the observed number of cancers was not significantly different from that expected. Conversely, a 95% CI that does not include 1.0 indicates that the observed number of cases was statistically significantly different, either higher or lower, from the expected number.

Results:

Table 1 shows the socio-demographic characteristics of the populations in the eight ZIP code area based on the 2000 and 2010 census data. There were some slight changes in the boundaries of ZIP codes 63042, 63043, and 63044 between 2000 and 2010 (Figure 1). The population increased slightly from 2000 to 2010 in ZIP codes 63034 and 63042, and decreased in the other ZIP codes (Table 1). The total population in the eight ZIP code area decreased 4.9 percent from 2000 to 2010. Age and gender compositions in the area were similar to that in the state, except for ZIP code 63044, which had a higher proportion of the senior population age 65 or older. There were higher proportions of African Americans in all eight ZIP codes than in the state, except for ZIP code 63043. The proportion of African Americans in the combined eight ZIP code area increased substantially from 2000 to 2010. However, the differences between the state population and the eight ZIP code area did not affect the comparisons between observed and expected cancer cases because age, gender and race were adjusted in the analysis. The proportion of people with less than a high school education or below poverty was higher than the state in ZIP code 63134 in 2000 and in ZIP codes 63134 and 63138 in 2010. All the other ZIP codes had lower proportions than in the state. Overall, the eight ZIP codes combined area had a lower proportion of people with less than a high school education or below poverty than the state (Table 1).

Tables A1-A9 show the observed and expected cancer cases in each ZIP code and the combined eight ZIP codes area. Table A10 summarizes the findings in tables A1-A9 and lists the cancers according to their association with ionizing radiation based on the scientific literature⁸. During 1996-2011, a total of 16,862 incident cases of cancer were reported to MCR from the area, with lung/bronchus/trachea/pleura (2,826), female breast (2,589), prostate (2,442), colon (1,475), and urinary bladder (720) cancers as the top five types of cancer in the area, which are the same as the state (Table A9). The total number of observed cancer cases was significantly higher in ZIP codes 63031, 63033, 63042, 63134, and the combined area than that expected based on the rates for the rest of the state (Table A10). Overall, there were 4.7 percent more cancer cases in the combined eight ZIP code area than was expected based on the rates for the rest of the state.

Evaluation of cancers frequently associated with radiation

Scientific studies have authoritatively linked exposure to ionizing radiation to the development of some types of cancer, primarily leukemia and thyroid cancer, and to a lesser degree, breast cancer. Authoritative risk estimates for these cancers have been developed and published in the scientific literature (Table A10) ⁸. This analysis found that the number of incident cases of leukemia was significantly higher than expected in the combined area (455 cases vs 411 cases) (Tables A9 & A10). Ninety-three percent of the excess cancer cases were from ZIP codes 63031, 63033, and 63043, the majority (65%) being from 63031 and 63033 (Tables A1, A2, & A5). The number of female breast cancer cases in ZIP codes 63033, 63042, 63134, and combined area was significantly higher than expected. On the other hand, the number of incident cases of thyroid cancer was significantly lower than expected in ZIP codes 63033, 63042, and the combined area (Table A10).

The proportion of leukemia subtypes,² including acute myeloid leukemia (AML), acute lymphocytic leukemia (ALL), chronic myeloid leukemia (CML), chronic lymphocytic leukemia (CLL), and the other types, among all leukemia cases in ZIP codes 63031 and 63033 were similar to that in the rest of the state. In ZIP code 63043, the proportion CLL was higher than that in the rest of the state (40.7% vs 30.0%); and the proportion of acute subtypes of leukemia was lower than that in the rest of the state (24.1% vs 31.1% for AML, 3.7% vs 10.0% for ALL).

Evaluation of cancers occasionally associated with radiation

Scientific studies have occasionally associated several other types of cancer with exposure to ionizing radiation. Robust risk estimates have been published in scientific studies (Table A10) ⁸. This analysis found a significantly higher number of lung and bronchus cancer in ZIP codes 63031, 63042 and 63134, but a significantly lower number in ZIP codes 63033 and 63034; a significantly higher number of colon cancer cases in ZIP code 63138, and the combined area; a significantly higher number of liver cancer cases in ZIP codes 63042 and 63134, but a significantly lower number in ZIP code 63033; a significantly higher number of bladder cancer cases in ZIP code 63031 and the combined area; and a significantly lower number of stomach cancer cases in ZIP code 63044. The observed numbers of esophageal, ovarian, and brain and nervous system cancer cases were not significantly different from that expected for each ZIP code and the combined area (Table A10).

Evaluation of cancers rarely, or never or sporadically associated with radiation

For cancers that are rarely or never/sporadically associated with exposure to ionizing radiation and with no risk estimation ⁸, the analysis found a significantly higher number of kidney and renal pelvis cancer cases in the combined area; a significantly higher number of myeloma cases in ZIP code 63034; a significantly higher number of rectum/anus/rectosigmoid cancer cases in ZIP code 63134, but a significantly lower number of cases in ZIP code 63044 and a significantly higher number of prostate cancer cases in ZIP codes 63031, 63033, 63034, 63042; 63138, and the combined area. However, a significantly lower number of cervical cancer cases were observed in ZIP codes 63031, 63033, 63034, 63138, and the combined area (Table A10).

² National Research Council determined that ionizing radiation increases the risk of acute leukemia (AML and ALL) and chronic myeloid leukemia (CML).

Evaluation of cancer in children

Tables B1-B9 show the observed and expected cancer cases among children age 17 or younger in each ZIP code and the combined eight ZIP codes. All observed numbers that are smaller than six are suppressed to protect the confidentiality of the cancer patients. The only statistically significant finding is in ZIP code 63043, where the observed seven cases of brain and other nervous system cancer was significantly higher than the expected three cases (Table B5).

Additional analysis of leukemia elevation

Because we found that the number of incident cases of leukemia was significantly higher than expected for the combined eight ZIP code area, we further stratified the analysis for each ZIP code by age and gender, and by three different periods (1996-2000, 2001-2005, and 2006-2011) to identify which demographic group, geographic location, and time period contributed the most to the elevation of leukemia cases in this area.

Tables C1-C9 show the observed and expected number of incident cases of leukemia in each ZIP code and the combined area during 1996-2011, stratified by age and gender. We found a significantly higher than expected number of incident cases of leukemia among males age 65 or older in ZIP code 63031 (Table C1), and a significantly higher than expected number among females age 45-64 and among males age 65 or older in the combined area.

Table D shows the observed and expected number of incident cases of leukemia in each ZIP code and the combined area during 1996-2011, stratifying the three different periods: 1996- 2000, 2001-2005 and 2006-2011. No statistically significant findings were identified in any period for any individual ZIP code. However, there was a statistically significant increase in the number of leukemia cases in the area as a whole in 2006-2011. ZIP codes 63031 and 63033 contributed most to the elevation (82.5%) in the combined area during 2006-2011.

Based on the data from Table C and Table D, demographic groups that might have elevated leukemia were examined in depth to identify potential elevations for different time periods. Table E1 shows a higher than expected number of leukemia cases among females age 45-64 in ZIP code 63031 during 1996-2005. Table E2 shows a higher than expected number among males age 65 or older in ZIP code 63031 during 2006-2011. Table E3 shows a higher than expected number of leukemia cases among males age 45-64 in ZIP code 63033 during 2006-2011. Table E4 shows a higher than expected number of leukemia cases among males age 65 or older in the combined ZIP codes of 63031 and 63033 during 2006-2011. Overall, the data show that females age 45-64 in ZIP code 63031 during 1996-2005, males age 65 or older in ZIP code 63031 during 2006-2011, males age 45-64 in ZIP 63033 during 2006-2011 contribute 55 percent of excess leukemia cases in the combined area.

To put the level of elevation of leukemia cases in the area into context, we compared the observed number of leukemia cases in each of the eight ZIP codes and all eight ZIP codes combined to that expected based on the rate for the rest of St. Louis County, the rate from the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) Program (representative of the US as a whole), the rate for Jackson County (the second largest urban county in Missouri, only second to St. Louis County, located in the Kansas City Metropolitan Statistical Area) , and the rate for St. Louis City.

Table F shows that the observed number of cancer cases in each ZIP code and the combined area was not significantly different from that expected based on the rates for the rest of St. Louis County and the rates from the SEER program. The number of observed cases was significantly higher in the combined area when compared with that expected based on the rates for Jackson County, and the rest of the state. When compared with the expected number based on the rates for the City of St. Louis, the observed numbers of cases were significantly higher in ZIP codes 63031, 63033, 63043, 63134, and the combined area.

Discussion:

Missouri Cancer Registry (MCR) is mandated by the state law to collect cancer incidence data in Missouri. The MCR data for the period 1996-2011 have more than a 95 percent completion rate and MCR has been recognized by the North American Association of Central Cancer Registries (NAACCR) as a Gold-certified registry (meeting all criteria for completeness and quality) for many years. Therefore, the quality of cancer data used in this study is high. However, the possibility of a biased comparison in the incidence of cancers between the study area and the rest of the state cannot be completely ruled out. For example, hospitals in the study area might have a higher cancer-reporting rate than other parts of the state due to a higher awareness or a better hospital system. If this is the case, it is expected that there is a greater likelihood of finding a significantly higher cancer incidence in the area than in the rest of the state when actually there is no difference. In addition, the combined eight ZIP code area had a lower proportion of people with less than a high school education or below the poverty level than the state. Education and poverty were not adjusted in the analysis because individual cancer patient's education and income data are not collected by the MCR. Because women with a higher socio-economic status have a higher risk of breast cancer and a lower risk of cervical cancer, we expect a relatively higher incidence of breast cancer and lower incidence of cervical cancer in the area than in the rest of the state²⁻⁸, which is consistent with the findings in this study.

The thyroid gland is particularly sensitive to radiation. Thyroid cancer was the first solid tumor reported to be increased among Atomic bomb survivors⁸. In this study, the number of thyroid cancer cases was significantly lower than expected in ZIP codes 63033, 63042, and the combined area and not different from expected in the remaining ZIP codes during 1996-2011. This is not likely to be due to under-reporting of thyroid cancer because of the high quality of the hospitals in the St. Louis area.

Contaminants related to Coldwater Creek are primarily radium, thorium, and uranium, radioisotopes that preferentially deposit in bone when absorbed into the body. Iodine-131, a specific radioisotope associated with thyroid cancer is not known to be present at the site. This might explain why the incidence of thyroid cancer was not elevated in the area. A lower incidence of thyroid cancer in the area suggests the level of external radiation might not be elevated in the area. However, information is lacking on potential public exposure at the site and no assessment of exposure is made in this analysis.

Bone marrow is also very sensitive to radiation. Leukemia, a type of cancer that arises in the bone marrow, is the most common radiation-induced cancer⁸. In this study, we found the

number of incident cases of leukemia in the combined area was significantly higher than expected during 1996-2011.

Radiation is a moderate risk factor for breast cancer. It was linked to breast cancer among Japanese atomic bomb survivors due to mixed gamma and neutron radiation, and among young women who received radiation therapy to the chest, especially during puberty⁸. Meanwhile, there are many modifiable and non-modifiable risk factors for breast cancer, including age, race/ethnicity, family history and genetics, certain benign breast conditions, exposure to external hormones, having no children, having a first full-term pregnancy after age 30, drinking alcoholic beverages, physical inactivity, being overweight or obese, and having an unhealthy diet. Unhealthy diet, lack of physical activity, and overweight/obesity are risk factors also shared by prostate, colorectal, kidney and renal pelvis, and bladder cancers, for which the area also has higher than expected numbers.

Cigarette smoking is the primary risk factor for the development of lung cancer with about 80 to 90 percent of all lung cancers attributable to smoking. The risk of lung cancer increases with the number of cigarettes smoked (i.e., quantity) and the time over which smoking has occurred (i.e., duration). The risk of developing lung cancer decreases each year following smoking cessation as normal cells grow and replace damaged cells in the lung. In addition, tobacco use is a risk factor for kidney and colon cancers and it likely increases the risk of breast cancer and an aggressive form of prostate cancer⁸. The number of lung cancer cases was lower in two ZIP codes and higher in another three ZIP codes, and overall; it is not higher in the combined area.

There are many risk factors for colon cancer, including older age, being African-American or Ashkenazi Jew, history of colorectal polyp and inflammatory bowel disease, family history, inherited syndromes, type 2 diabetes, unhealthy diet, physical inactivity, obesity/overweight, smoking, heavy alcohol use, and lack of screening among those age 50 or older. Ionizing radiation was found to be linked with colon cancer among Japanese atomic bomb survivors and among women who received a cumulative total of up to 5-10 Gray x-ray treatments in the pelvic area. No associations were found in other studies conducted among nuclear workers, radiologists, or other medical treatments⁸.

There are many risk factors for bladder cancer as well. Tobacco use is the greatest risk factor for bladder cancer. Smokers, including pipe and cigar smokers, are two to three times more likely than nonsmokers to get bladder cancer. Other risk factors include increasing age; being white; being a man; occupational exposure to certain chemicals such as aromatic amines, polycyclic hydrocarbons, and hair dye; chronic bladder irritation and infections; exposure to chemotherapy and radiation therapy; arsenic in drinking water; certain medicines or herbal supplements use; genetics and family history; personal history of bladder or other urothelial cancer. Fruit and vegetable consumption and physical activity are associated with decreased risk of bladder cancer. Ionizing radiation was linked to bladder cancer among Japanese atomic bomb survivors, and women who received therapeutic radiation therapy. No associations were found in other studies conducted among radiologists/technicians, underground miners, nuclear workers, and uranium processors⁸.

While the exact cause of multiple myeloma is not known, the factors that increase the risk of

developing multiple myeloma are primarily non-modifiable and include: age (generally 65 and older), race (African-Americans have higher risk), sex (men have slightly higher incidence than women), family history of multiple myeloma and genetic precursor conditions. Exposure to radiation is suspected to increase the risk of multiple myeloma among Japanese atomic bomb survivors, nuclear workers, radiologists, and radium dial painters; however, the association has not been confirmed⁸.

The exact cause of a brain cancer is unknown, but there are a few risk factors. Brain cancers are more common in early childhood and among older adults. In general, men are more likely than women to develop a brain cancer. About 5% of brain cancer cases may be linked to hereditary genetic factors or conditions, including Li-Fraumeni syndrome, neurofibromatosis, nevoid basal cell carcinoma syndrome, tuberous sclerosis, Turcot syndrome, and von Hippel-Lindau disease. Previous treatment to the brain or head with ionizing radiation has shown to increase the risk of brain tumors⁸.

One limitation of this study is that the 2000 and 2010 Census ZIP Code Tabulation Area (ZCTA) populations were used to estimate the population for the ZIP codes and the combined area during 1996-2011. This was done because no inter-census population data were available at the U.S. Postal Service ZIP code level. In doing so, we assumed the population changes in the ZIP codes and the combined area during 1996-2011 followed a linear pattern. In addition, there were some slight changes in the ZCTA boundaries between 2000 and 2010 for ZIP codes 63042, 63043, 63044. However, these changes are small and unlikely to significantly affect the study results. Another limitation of this study is that it is a surveillance-based study, which estimates the overall risk for the population in each ZIP code and the combined area. Individuals in the area may have large variations in both exposure dose and duration. Some cancer patients might have been exposed to radiation in their occupation. However, data on exposure dose and duration and complete occupation information are not available in the cancer registry database and cannot be taken into account in this analysis.

While the initial radiological contamination occurred in the 1940s and remedial actions have been ongoing since the late 1980s, the earliest year of diagnosis included in this study was 1996. This was because 1996 was the first year of high-quality population-based data in the MCR database. Individuals who were exposed but moved away from the area before 1996 are not included regardless of whether they were later diagnosed with cancer due to the lack of addresses prior to diagnosis in the MCR database. Some former residents may have left Missouri entirely (and be outside of the MCR catchment area). Additionally, it is not feasible to calculate expected number of cancer cases if both former and current residents of the area are included in the study. Conversely, individuals who subsequently moved into the area post-remediation are included even though their cancer diagnoses may be unrelated to exposure to Coldwater Creek. Another consideration is that those who moved into the area without cancer may make it more difficult to detect any increased incidence caused by Coldwater Creek because they cannot be eliminated from the study because the length of residency is in neither the MCR database nor the population file.

Before drawing conclusions from these data, some aspects of the statistical method need to be considered. First, random fluctuations in the disease occurrence cannot be completely ruled out

in explaining differences between observed and expected numbers, even when the difference is statistically significant. The problem of random fluctuation is expected to be more prominent as the study areas become smaller. The second aspect is the power of the statistical test; that is, the probability that a true departure from the expected number can be detected by significance testing. A non-significant difference sometimes reflects low statistical power rather than the absence of differences. In this study, the power of detecting a difference was higher for the designated area than for each individual ZIP code. Third, when making so many comparisons, the play of chance might contribute to the observed findings; e.g., if 100 comparisons are made, five might be expected to be significantly high or low based on chance alone. Overall there were 870 comparisons in this study; therefore, we could expect up to 43 significantly high or low results based on chance alone. Finally, the significance of elevation of cancer cases depends on the reference population the study used. In this case, the leukemia cases were significantly elevated when compared to the rest of the state of Missouri, but not so when compared with the US as whole based on SEER rate.

Conclusions and Recommendations:

In the combined ZIP code area during 1996-2011, the number of incident cases of leukemia was statistically significantly higher, and the number of incident cases of thyroid cancer was statistically significantly lower than that expected based on the rate for the rest of the state. The majority of excess leukemia cases were from ZIP codes 63031, and 63033, especially from females age 45-64 in ZIP code 63031 during 1996-2005, males age 65 or older in ZIP code 63031 during 2006-2011, and males age 45-64 in ZIP 63033 during 2006-2011. The number of female breast cancer cases was statistically significantly higher than expected, as was the number of colon, prostate, kidney and bladder cancers in the area. These cancers share common risk factors including unhealthy diets, lack of physical activity, obesity, smoking, and diabetes. The number of incident cases of brain and other nervous system cancer among children age 17 or younger was significantly higher than expected in ZIP code 64043 during 1996-2011.

While there were significant elevations in the number of leukemia cases, the number of thyroid cancer cases was significantly lower than expected in two ZIP codes and the combined area. While the elevations are important, and should be examined further, the lack of information on potential public exposure is equally important, and should be further investigated as well.

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References:

1. Bailar JC, Ederer F: Significance factors for the ratio of a Poisson variable to its expectation. *Biometrics* 1964; 20:639-43.
2. Yost K, Perkins C, Cohen R, et al. Socioeconomic status and breast cancer incidence in California for different race/ethnic groups. *Cancer Causes Control*. 12: 703-11, 2001.
3. Heck KE and Pamuk ER. Explaining the relation between education and postmenopausal breast cancer. *Am J Epidemiol*. 145: 366-72, 1997.
4. Braaten T, Weiderpass E, Kumle M, et al. Education and risk of breast cancer in the Norwegian-Swedish women's lifestyle and health cohort study. *Int J Cancer*. 110: 579-83, 2004.
5. Braaten T, Weiderpass E, Kumle M, Lund E. Explaining the socioeconomic variation in cancer risk in the Norwegian Women and Cancer Study. *Cancer Epidemiol Biomarkers Prev*. 14(11 Pt 1):2591-7, 2005.
6. Fujino Y, Mori M, Tamakoshi A, et al. for the JACC Study Group. A prospective study of educational background and breast cancer among Japanese women. *Cancer Causes Control*. 19(9):931-7, 2008.
7. Keegan TH, John EM, Fish KM, Alfaro-Velcamp T, Clarke CA, Gomez SL. Breast cancer incidence patterns among California Hispanic women: differences by nativity and residence in an enclave. *Cancer Epidemiol Biomarkers Prev*. 19(5):1208-18, 2010.
8. Schottenfeld D & Fraumeni J. *Cancer Epidemiology and Prevention*. 2nd edition. Oxford University Press, 1996.
9. Cancer prevention overview. National Cancer Institute, Accessed at: <http://www.cancer.gov/cancertopics/pdq/prevention/overview/patient/page3#Keypoint6>.
10. What causes cancer? American Cancer Society. Accessed at: <http://www.cancer.org/cancer/cancercauses/index>.
11. Radiation exposure and cancer. American Cancer Society. Accessed at: <http://www.cancer.org/cancer/cancercauses/othercarcinogens/medicaltreatments/radiation-exposure-and-cancer>.

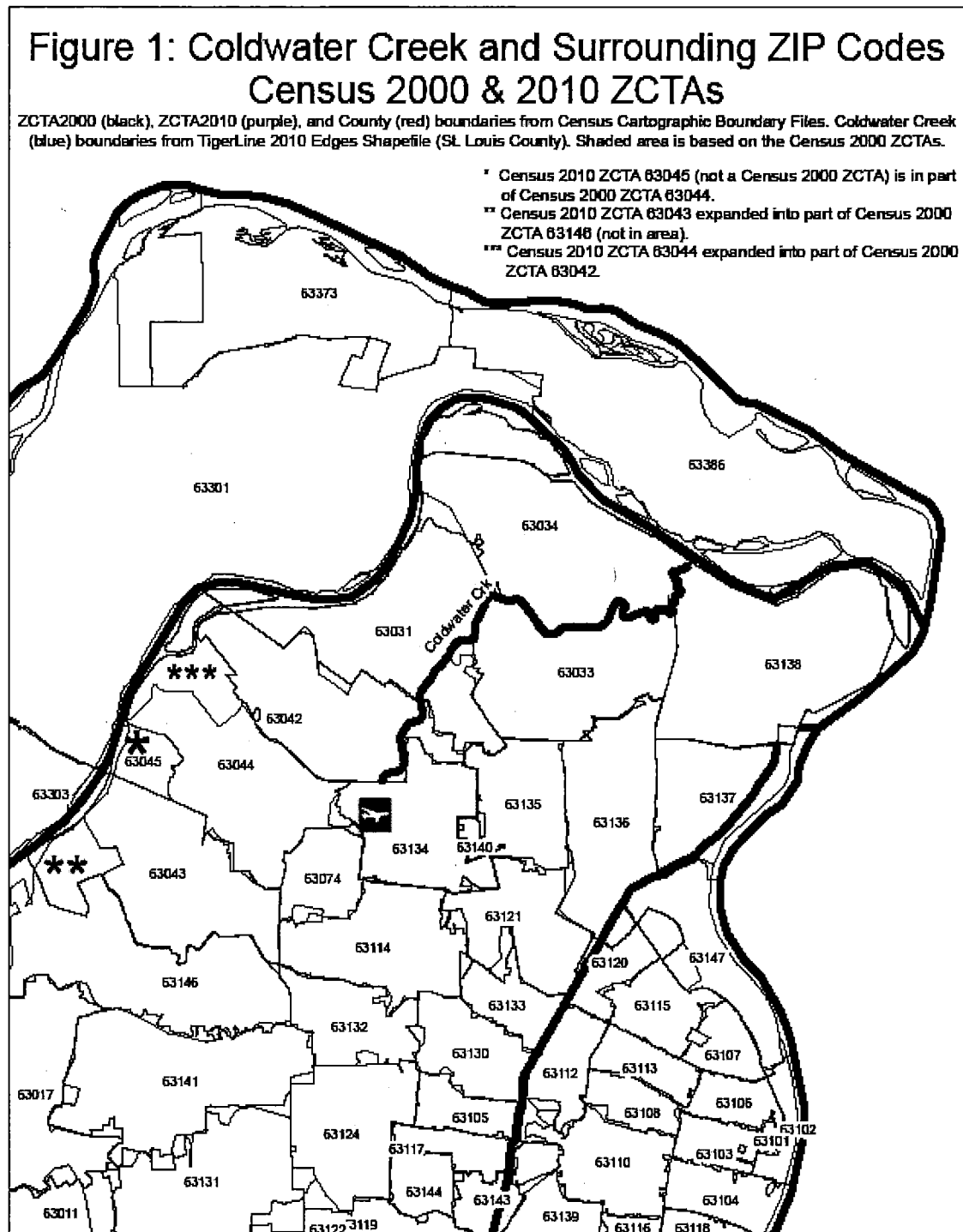


Table 1. Socio-demographic characteristics of the population in the Coldwater Creek area and the State

Geographic Area	Total population		Percentage (%)									
			>64yrs		Male		African American		< High school education*		Below poverty**	
	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010
63031	50,013	48,212	13.7	13.7	47.6	47.1	11.3	23.6	13.3	9.2	4.1	7.5
63033	45,574	43,000	15.7	15.7	46.2	45.9	43.4	60.7	12.4	8.4	4.1	10.4
63034	16,803	17,761	10.7	13.7	48.4	47.6	29.0	53.9	7.4	6.0	1.9	3.2
63042	19,162	19,602	11.9	12.3	48.0	46.9	18.1	32.8	12.6	9.5	6.8	11.3
63043	22,401	22,362	10.5	14.0	48.9	48.9	5.2	9.6	12.2	10.4	4.8	7.2
63044	14,623	10,568	16.1	21.5	48.2	46.8	7.8	15.2	13.4	8.6	4.7	14.7
63134	14,982	13,638	11.6	10.9	45.8	46.0	57.9	62.7	22.5	18.2	16.3	21.5
63138	21,879	20,175	11.1	10.4	46.5	44.9	53.8	75.8	17.7	14.5	11.6	26.0
All 8 ZIP codes	205,437	195,318	13.1	13.9	47.3	46.7	27.5	41.5	13.6	10.0	6.0	11.4
State of Missouri	5,595,211	5,988,927	13.5	14.0	48.6	49.0	11.3	11.6	18.7	12.8	11.7	15.0

Source: U.S. Census Bureau, 2010 Census. 2010 Demographic Profile Data; Census 2000 population counts from the Census 2000 SF1 table P012 (Sex by Age).

*The populations and percentages of "less than High School Education" are for the population 25 Years and over, from the Census 2000 SF3 (sample data) table P037; 2010 data are from the 2008-2012 American Community Survey.

**The populations and percentages of "Below Poverty" are for the population in 1999 for whom poverty status is determined, from the Census 2000 SF3 (sample data) table P087; 2010 data are from the 2008-2012 American Community Survey.

Table A1. Number of observed and expected incident cases of cancers in Zip code 63031, 1996 – 2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	93	90.20	1.03	0.83	1.26	
Pharynx (naso-, oro-, & hypo-)	13	13.53	0.96	0.51	1.64	
Salivary gland	9	9.14	0.98	0.45	1.87	
Esophagus	38	41.35	0.92	0.65	1.26	
Stomach	49	46.98	1.04	0.77	1.38	
Colon	334	330.19	1.01	0.91	1.13	
Appendix	7	5.68	1.23	0.49	2.54	
Rectum, anus, rectosigmoid	136	128.55	1.06	0.89	1.25	
Liver	35	38.99	0.90	0.63	1.25	
Pancreas	98	99.14	0.99	0.80	1.20	
Larynx	42	38.08	1.10	0.79	1.49	
Trachea, bronchus, lung, pleura	731	664.91	1.10	1.02	1.18	SH
Bones and Joints	~	7.30	0.41	0.08	1.20	
Soft Tissue including Heart	17	25.36	0.67	0.39	1.07	
Melanoma of the Skin	112	113.45	0.99	0.81	1.19	
Female Breast	600	589.27	1.02	0.94	1.10	
Cervix Uteri	27	40.06	0.67	0.44	0.98	SL
Corpus Uteri	125	112.53	1.11	0.92	1.32	
Ovary	55	57.82	0.95	0.72	1.24	
Prostate	530	470.57	1.13	1.03	1.23	SH
Testis	20	17.39	1.15	0.70	1.78	
Urinary Bladder	196	163.18	1.20	1.04	1.38	SH
Kidney and Renal Pelvis	142	126.63	1.12	0.94	1.32	
Renal pelvis	~	7.03	0.71	0.23	1.66	
Brain and other nervous system	67	55.85	1.20	0.93	1.52	
Thyroid	59	74.59	0.79	0.60	1.02	
Hodgkin disease	26	21.17	1.23	0.80	1.80	
Non-Hodgkin Lymphoma	149	156.27	0.95	0.81	1.12	
Multiple Myeloma	38	46.97	0.81	0.57	1.11	
Leukemia	117	102.37	1.14	0.95	1.37	
Other	228	236.51	0.96	0.84	1.10	
Gallbladder	10	9.53	1.05	0.50	1.93	
Male breast	~	3.70	1.08	0.29	2.77	
Intrahepatic bile duct	7	5.86	1.19	0.48	2.46	
Other including bone, liver, soft tissue	283	308.16	0.92	0.81	1.03	
Total	4067	3895.70	1.04	1.01	1.08	SH

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study).
SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table A2. Number of observed and expected incident cases of cancers in Zip code 63033, 1996 – 2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	77	89.06	0.86	0.68	1.08	
Pharynx (nasopharynx, oropharynx, & hypopharynx)	13	16.62	0.78	0.42	1.34	
Salivary gland	15	9.11	1.65	0.92	2.71	
Esophagus	35	47.49	0.74	0.51	1.02	
Stomach	56	57.29	0.98	0.74	1.27	
Colon	390	358.05	1.09	0.98	1.20	
Appendix	10	5.30	1.89	0.90	3.47	
Rectum, anus, rectosigmoid	137	131.12	1.04	0.88	1.24	
Liver	37	53.46	0.69	0.49	0.95	SL
Pancreas	122	110.91	1.10	0.91	1.31	
Larynx	36	42.66	0.84	0.59	1.17	
Trachea, bronchus, lung, pleura	644	707.71	0.91	0.84	0.98	SL
Bones and Joints	10	6.35	1.57	0.75	2.90	
Soft Tissue including Heart	28	25.23	1.11	0.74	1.60	
Melanoma of the Skin	74	77.82	0.95	0.75	1.19	
Female Breast	648	584.16	1.11	1.03	1.20	SH
Cervix Uteri	25	43.35	0.58	0.37	0.85	SL
Corpus Uteri	115	105.72	1.09	0.90	1.31	
Ovary	54	52.41	1.03	0.77	1.34	
Prostate	684	535.95	1.28	1.18	1.38	SH
Testis	8	9.39	0.85	0.37	1.68	
Urinary Bladder	163	153.96	1.06	0.90	1.23	
Kidney and Renal Pelvis	151	131.67	1.15	0.97	1.35	
Renal pelvis	9	6.56	1.37	0.63	2.60	
Brain and other nervous system	49	45.84	1.07	0.79	1.41	
Thyroid	39	61.16	0.64	0.45	0.87	SL
Hodgkin disease	23	18.94	1.21	0.77	1.82	
Non-Hodgkin Lymphoma	147	145.59	1.01	0.85	1.19	
Multiple Myeloma	63	59.51	1.06	0.81	1.35	
Leukemia	114	99.97	1.14	0.94	1.37	
Other	209	249.44	0.84	0.73	0.96	SL
Gallbladder	13	10.55	1.23	0.66	2.11	
Male breast	~	4.52	0.66	0.13	1.94	
Intrahepatic bile duct	~	6.27	0.48	0.10	1.40	
Other including bone, liver, soft tissue	284	334.48	0.85	0.75	0.95	SL
Total	4138	4004.21	1.03	1.00	1.07	SH

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table A3. Number of observed and expected incident cases of cancers in Zip code 63034, 1996 – 2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	21	35.52	0.59	0.37	0.90	SL
Pharynx (naso-, oro-, & hypo-)	~	6.56	0.61	0.16	1.56	
Salivary gland	~	3.25	0.31	0.00	1.71	
Esophagus	13	17.55	0.74	0.39	1.27	
Stomach	19	19.51	0.97	0.59	1.52	
Colon	132	117.37	1.12	0.94	1.33	
Appendix	~	2.09	0.48	0.01	2.67	
Rectum, anus, rectosigmoid	49	47.75	1.03	0.76	1.36	
Liver	14	20.40	0.69	0.37	1.15	
Pancreas	27	36.77	0.73	0.48	1.07	
Larynx	9	16.75	0.54	0.25	1.02	
Trachea, bronchus, lung, pleura	190	248.23	0.77	0.66	0.88	SL
Bones and Joints	~	2.44	0.82	0.09	2.96	
Soft Tissue including Heart	10	9.18	1.09	0.52	2.00	
Melanoma of the Skin	37	31.96	1.16	0.81	1.60	
Female Breast	219	207.88	1.05	0.92	1.20	
Cervix Uteri	6	15.75	0.38	0.14	0.83	SL
Corpus Uteri	38	37.79	1.01	0.71	1.38	
Ovary	21	18.25	1.15	0.71	1.76	
Prostate	280	208.06	1.35	1.19	1.51	SH
Testis	~	4.12	0.49	0.05	1.75	
Urinary Bladder	49	52.93	0.93	0.68	1.22	
Kidney and Renal Pelvis	61	49.12	1.24	0.95	1.60	
Renal pelvis	~	2.18	0.46	0.01	2.56	
Brain and other nervous system	15	17.59	0.85	0.48	1.41	
Thyroid	20	25.11	0.80	0.49	1.23	
Hodgkin disease	8	7.14	1.12	0.48	2.21	
Non-Hodgkin Lymphoma	50	51.60	0.97	0.72	1.28	
Multiple Myeloma	31	20.00	1.55	1.05	2.20	SH
Leukemia	31	34.34	0.90	0.61	1.28	
Other	61	82.68	0.74	0.56	0.95	SL
Gallbladder	~	3.30	1.21	0.33	3.10	
Male breast	~	1.70	0.59	0.01	3.27	
Intrahepatic bile duct	~	2.12	0.47	0.01	2.62	
Other including bone, liver, soft tissue	87	114.70	0.76	0.61	0.94	SL
Total	1415	1435.78	0.99	0.93	1.04	

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table A4. Number of observed and expected incident cases of cancers in Zip code 63042, 1996 – 2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	29	33.17	0.87	0.59	1.26	
Pharynx (naso-, oro-, & hypo-)	~	5.25	0.57	0.11	1.67	
Salivary gland	~	3.32	1.51	0.49	3.52	
Esophagus	19	15.12	1.26	0.76	1.96	
Stomach	15	16.97	0.88	0.49	1.46	
Colon	126	114.74	1.10	0.91	1.31	
Appendix	~	2.10	1.43	0.29	4.17	
Rectum, anus, rectosigmoid	59	46.18	1.28	0.97	1.65	
Liver	24	14.99	1.60	1.03	2.38	SH
Pancreas	44	34.79	1.26	0.92	1.70	
Larynx	19	14.21	1.34	0.80	2.09	
Trachea, bronchus, lung, pleura	282	240.03	1.17	1.04	1.32	SH
Bones and Joints	0	2.72	~	0.00	~	
Soft Tissue including Heart	8	9.52	0.84	0.36	1.66	
Melanoma of the Skin	51	39.60	1.29	0.96	1.69	
Female Breast	248	214.90	1.15	1.01	1.31	SH
Cervix Uteri	14	15.73	0.89	0.49	1.49	
Corpus Uteri	40	40.77	0.98	0.70	1.34	
Ovary	22	20.44	1.08	0.67	1.63	
Prostate	202	174.40	1.16	1.00	1.33	SH
Testis	7	6.71	1.04	0.42	2.15	
Urinary Bladder	64	56.30	1.14	0.88	1.45	
Kidney and Renal Pelvis	39	46.32	0.84	0.60	1.15	
Renal pelvis	~	2.40	1.25	0.25	3.66	
Brain and other nervous system	26	20.22	1.29	0.84	1.88	
Thyroid	13	28.19	0.46	0.25	0.79	SL
Hodgkin disease	7	8.43	0.83	0.33	1.71	
Non-Hodgkin Lymphoma	61	55.75	1.09	0.84	1.41	
Multiple Myeloma	15	17.14	0.87	0.49	1.44	
Leukemia	36	36.09	1.00	0.70	1.38	
Other	91	82.66	1.10	0.89	1.35	
Gallbladder	~	3.34	0.60	0.07	2.16	
Male breast	~	1.36	1.48	0.17	5.33	
Intrahepatic bile duct	~	2.10	0.95	0.11	3.44	
Other including bone, liver, soft tissue	123	109.89	1.12	0.93	1.34	
Total	1561	1406.11	1.11	1.06	1.17	SH

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table A5. Number of observed and expected incident cases of cancers in Zip code 63043, 1996 – 2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	39	39.51	0.99	0.70	1.35	
Pharynx (nasopharynx, oropharynx, & hypopharynx)	~	5.96	0.84	0.27	1.96	
Salivary gland	7	3.83	1.83	0.73	3.76	
Esophagus	17	17.00	1.00	0.58	1.60	
Stomach	22	19.21	1.15	0.72	1.73	
Colon	119	130.77	0.91	0.75	1.09	
Appendix	~	2.49	1.20	0.24	3.52	
Rectum, anus, rectosigmoid	50	54.04	0.93	0.69	1.22	
Liver	18	16.34	1.10	0.65	1.74	
Pancreas	36	39.39	0.91	0.64	1.27	
Larynx	14	16.15	0.87	0.47	1.45	
Trachea, bronchus, lung, pleura	271	273.73	0.99	0.88	1.12	
Bones and Joints	6	3.20	1.88	0.69	4.08	
Soft Tissue including Heart	11	10.89	1.01	0.50	1.81	
Melanoma of the Skin	59	51.73	1.14	0.87	1.47	
Female Breast	250	248.25	1.01	0.89	1.14	
Cervix Uteri	13	17.32	0.75	0.40	1.28	
Corpus Uteri	42	48.60	0.86	0.62	1.17	
Ovary	19	24.57	0.77	0.47	1.21	
Prostate	215	200.21	1.07	0.94	1.23	
Testis	8	8.96	0.89	0.38	1.76	
Urinary Bladder	81	67.61	1.20	0.95	1.49	
Kidney and Renal Pelvis	51	53.39	0.96	0.71	1.26	
Renal pelvis	0	2.87	~	0.00	~	
Brain and other nervous system	32	24.73	1.29	0.88	1.83	
Thyroid	38	35.34	1.08	0.76	1.48	
Hodgkin disease	~	9.55	0.52	0.17	1.22	
Non-Hodgkin Lymphoma	66	65.85	1.00	0.78	1.28	
Multiple Myeloma	12	18.26	0.66	0.34	1.15	
Leukemia	54	42.10	1.28	0.96	1.67	
Other	111	94.88	1.17	0.96	1.41	
Gallbladder	~	3.79	1.32	0.42	3.08	
Male breast	~	1.52	2.63	0.71	6.74	
Intrahepatic bile duct	~	2.47	1.21	0.24	3.55	
Other including bone, liver, soft tissue	146	125.30	1.17	0.98	1.37	
Total	1659	1631.59	1.02	0.97	1.07	

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table A6. Number of observed and expected incident cases of cancers in Zip code 63044, 1996 – 2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	28	29.17	0.96	0.64	1.39	
Pharynx (naso-, oro-, & hypo-)	7	4.25	1.65	0.66	3.39	
Salivary gland	~	2.93	1.02	0.21	2.99	
Esophagus	11	13.39	0.82	0.41	1.47	
Stomach	7	15.28	0.46	0.18	0.94	SL
Colon	125	109.90	1.14	0.95	1.36	
Appendix	~	1.75	1.14	0.13	4.12	
Rectum, anus, rectosigmoid	25	41.89	0.60	0.39	0.88	SL
Liver	14	12.19	1.15	0.63	1.93	
Pancreas	32	32.85	0.97	0.67	1.38	
Larynx	7	12.18	0.57	0.23	1.18	
Trachea, bronchus, lung, pleura	210	219.54	0.96	0.83	1.10	
Bones and Joints	~	2.10	1.43	0.29	4.18	
Soft Tissue including Heart	7	7.63	0.92	0.37	1.89	
Melanoma of the Skin	87	36.55	1.01	0.71	1.40	
Female Breast	199	187.81	1.06	0.92	1.22	
Cervix Uteri	15	11.04	1.36	0.76	2.24	
Corpus Uteri	45	36.79	1.22	0.89	1.64	
Ovary	22	18.88	1.17	0.73	1.76	
Prostate	177	154.97	1.14	0.98	1.32	
Testis	~	4.48	1.12	0.36	2.60	
Urinary Bladder	59	55.58	1.06	0.81	1.37	
Kidney and Renal Pelvis	47	40.63	1.16	0.85	1.54	
Renal pelvis	~	2.42	0.83	0.09	2.99	
Brain and other nervous system	10	17.09	0.59	0.28	1.08	
Thyroid	17	21.78	0.78	0.45	1.25	
Hodgkin disease	~	5.76	0.69	0.19	1.78	
Non-Hodgkin Lymphoma	53	51.31	1.03	0.77	1.35	
Multiple Myeloma	20	15.02	1.33	0.81	2.06	
Leukemia	37	32.85	1.13	0.79	1.55	
Other	85	78.17	1.09	0.87	1.34	
Gallbladder	~	3.20	0.31	0.00	1.74	
Male breast	~	1.19	1.68	0.19	6.06	
Intrahepatic bile duct	~	1.97	1.01	0.11	3.66	
Other including bone, liver, soft tissue	109	100.09	1.09	0.89	1.31	
Total	1301	1264.82	1.03	0.97	1.09	

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table A7. Number of observed and expected incident cases of cancers in Zip code 63134, 1996 – 2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	33	23.05	1.43	0.99	2.01	
Pharynx (naso-, oro-, & hypo-)	7	4.74	1.48	0.59	3.04	
Salivary gland	~	2.32	2.16	0.70	5.03	
Esophagus	12	12.46	0.96	0.50	1.68	
Stomach	15	15.58	0.96	0.54	1.59	
Colon	96	89.50	1.07	0.87	1.31	
Appendix	~	1.45	0.69	0.01	3.85	
Rectum, anus, rectosigmoid	53	33.50	1.58	1.18	2.07	SH
Liver	24	15.04	1.60	1.02	2.37	SH
Pancreas	24	28.33	0.85	0.54	1.26	
Larynx	27	11.38	2.37	1.56	3.45	SH
Trachea, bronchus, lung, pleura	244	179.26	1.36	1.20	1.54	SH
Bones and Joints	~	1.89	2.12	0.57	5.42	
Soft Tissue including Heart	~	7.09	0.56	0.15	1.44	
Melanoma of the Skin	19	17.33	1.10	0.66	1.71	
Female Breast	187	155.58	1.20	1.04	1.39	SH
Cervix Uteri	14	13.28	1.05	0.58	1.77	
Corpus Uteri	31	27.62	1.12	0.76	1.59	
Ovary	21	13.26	1.58	0.98	2.42	
Prostate	137	138.52	0.99	0.83	1.17	
Testis	~	2.79	1.08	0.22	3.15	
Urinary Bladder	45	34.88	1.29	0.94	1.73	
Kidney and Renal Pelvis	34	34.42	0.99	0.68	1.38	
Renal pelvis	~	1.47	1.36	0.15	4.90	
Brain and other nervous system	17	12.11	1.40	0.82	2.25	
Thyroid	14	17.39	0.81	0.44	1.35	
Hodgkin disease	8	5.76	1.39	0.60	2.74	
Non-Hodgkin Lymphoma	43	35.66	1.21	0.87	1.62	
Multiple Myeloma	15	16.29	0.92	0.51	1.52	
Leukemia	28	25.44	1.10	0.73	1.59	
Other	90	62.78	1.43	1.15	1.76	SH
Gallbladder	~	2.69	1.49	0.40	3.81	
Male breast	~	1.20	2.50	0.50	7.32	
Intrahepatic bile duct	~	1.60	1.87	0.38	5.48	
Other including bone, liver, soft tissue	122	86.80	1.41	1.17	1.68	SH
Total	1242	1030.18	1.21	1.14	2.01	SH

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table A8. Number of observed and expected incident cases of cancers in Zip code 63138, 1996 – 2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	28	32.82	0.85	0.57	1.23	
Pharynx (naso-, oro-, & hypo-)	7	6.29	1.11	0.45	2.29	
Salivary gland	~	3.48	0.57	0.06	2.07	
Esophagus	13	16.82	0.77	0.41	1.32	
Stomach	20	20.40	0.98	0.60	1.51	
Colon	153	124.77	1.23	1.04	1.44	SH
Appendix	~	2.01	0.50	0.01	2.77	
Rectum, anus, rectosigmoid	40	46.97	0.85	0.61	1.16	
Liver	21	19.53	1.08	0.67	1.64	
Pancreas	36	38.48	0.94	0.66	1.30	
Larynx	11	15.36	0.72	0.36	1.28	
Trachea, bronchus, lung, pleura	254	245.29	1.04	0.91	1.17	
Bones and Joints	~	2.70	0.74	0.08	2.67	
Soft Tissue including Heart	7	10.33	0.68	0.27	1.40	
Melanoma of the Skin	25	27.53	0.91	0.59	1.34	
Female Breast	238	212.54	1.12	0.98	1.27	
Cervix Uteri	~	18.07	0.28	0.09	0.65	SL
Corpus Uteri	32	37.03	0.86	0.59	1.22	
Ovary	19	18.52	1.03	0.62	1.60	
Prostate	217	187.85	1.16	1.01	1.32	SH
Testis	~	3.91	1.02	0.28	2.62	
Urinary Bladder	63	53.38	1.18	0.91	1.51	
Kidney and Renal Pelvis	52	47.74	1.09	0.81	1.43	
Renal pelvis	0	2.24	~	0.00	~	
Brain and other nervous system	14	17.83	0.79	0.43	1.32	
Thyroid	15	24.50	0.61	0.34	1.01	
Hodgkin disease	9	8.57	1.05	0.48	1.99	
Non-Hodgkin Lymphoma	45	53.24	0.85	0.62	1.13	
Multiple Myeloma	23	21.07	1.09	0.69	1.64	
Leukemia	38	37.47	1.01	0.72	1.39	
Other	95	89.69	1.06	0.86	1.29	
Gallbladder	~	3.69	0.54	0.06	1.96	
Male breast	~	1.61	1.24	0.14	4.48	
Intrahepatic bile duct	0	2.20	~	0.00	~	
Other including bone, liver, soft tissue	125	122.25	1.02	0.85	1.22	
Total	1479	1432.42	1.03	0.98	1.09	

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table A9. Number of observed and expected incident cases of cancers in eight Zip codes combined, 1996 – 2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	348	372.49	0.93	0.84	1.04	
Pharynx (naso-, oro-, & hypo-)	59	63.21	0.93	0.71	1.20	
Salivary gland	47	37.38	1.26	0.92	1.67	
Esophagus	158	181.17	0.87	0.74	1.02	
Stomach	203	211.21	0.96	0.83	1.10	
Colon	1475	1375.29	1.07	1.02	1.13	SH
Appendix	28	22.86	1.22	0.81	1.77	
Rectum, anus, rectosigmoid	549	530.00	1.04	0.95	1.13	
Liver	187	190.93	0.98	0.84	1.13	
Pancreas	419	420.66	1.00	0.90	1.10	
Larynx	165	166.78	0.99	0.84	1.15	
Trachea, bronchus, lung, pleura	2826	2778.71	1.02	0.98	1.06	
Bones and Joints	30	28.70	1.05	0.71	1.49	
Soft Tissue including Heart	92	105.24	0.87	0.70	1.07	
Melanoma of the Skin	414	395.97	1.05	0.95	1.15	
Female Breast	2589	2400.39	1.08	1.04	1.12	SH
Cervix Uteri	119	174.60	0.68	0.56	0.82	SL
Corpus Uteri	468	446.85	1.05	0.95	1.15	
Ovary	233	224.16	1.04	0.91	1.18	
Prostate	2442	2070.53	1.18	1.13	1.23	SH
Testis	57	57.75	0.99	0.75	1.28	
Urinary Bladder	720	637.82	1.13	1.05	1.21	SH
Kidney and Renal Pelvis	577	529.91	1.09	1.00	1.18	SH
Renal pelvis	22	27.17	0.81	0.51	1.23	
Brain and other nervous system	230	211.27	1.09	0.95	1.24	
Thyroid	215	288.06	0.75	0.65	0.85	SL
Hodgkin disease	90	85.32	1.05	0.85	1.30	
Non-Hodgkin Lymphoma	614	615.27	1.00	0.92	1.08	
Multiple Myeloma	217	214.27	1.01	0.88	1.16	
Leukemia	455	410.62	1.11	1.01	1.21	SH
Other	970	976.82	0.99	0.93	1.06	
Gallbladder	41	40.10	1.02	0.73	1.39	
Male breast	21	16.80	1.25	0.77	1.91	
Intrahepatic bile duct	21	24.59	0.85	0.53	1.31	
Other including bone, liver, soft tissue	1279	1301.68	0.98	0.93	1.04	
Total	16862	16100.81	1.05	1.03	1.06	SH

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected.

Table A10. Summary of Table A1-A9 For Cancer Data During 1996-2011

Type of Cancer and Its Association with Radiation	63031	63033	63034	63042	63043	63044	63134	63138	All 8 ZIP Codes
Cancers Frequently Associated with Radiation with Authoritative Risk Estimates									
<i>Leukemia</i>									
<i>Thyroid</i>		SL		SL					SH
Female breast		SH		SH			SH		SH
Cancers Occasionally Associated with Radiation with Robust Risk Estimates									
<i>Lung</i>	SH	SL	SL	SH			SH		
<i>Stomach</i>						SL			
<i>Colon</i>							SH		SH
<i>Esophagus</i>									
<i>Bladder</i>	SH								SH
<i>Ovary</i>									
<i>Brain and nervous system</i>									
<i>Liver</i>			SL	SH			SH		
Cancers Rarely Associated with Radiation with Uncertain Risk Estimates									
<i>Kidney</i>									SH
<i>Salivary glands</i>									
<i>Non-Hodgkin lymphoma</i>			SH						
<i>Myeloma</i>									
<i>Skin</i>						SL	SH		
<i>Rectum</i>									
<i>Uterus</i>									
<i>Bone</i>									
Connective tissues									
Cancers Never or Sporadically Associated with Radiation with No Risk Estimates									
<i>Chronic lymphocytic leukemia</i>									
<i>Pancreas</i>									
<i>Hodgkin disease</i>									
<i>Prostate</i>	SH	SH	SH	SH			SH		SH
<i>Testis</i>									
<i>Cervix</i>	SL	SL	SL				SL		SL
Certain Childhood cancers									
<i>Supporting tissues of skeleton</i>									
All Cancers	SH	SH		SH			SH		SH

SH: Significantly higher than expected. SL: Significantly lower than expected.

Table B1. Number of observed and expected incident cases of cancers among children age 17 or younger in ZIP code 63031, 1996-2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	~	0.45				
Pharynx (naso-, oro-, & hypo-)	0	0.24				
Salivary gland	~	0.14				
Esophagus	0	0.00				
Stomach	0	0.05				
Colon	0	0.08				
Appendix	0	0.02				
Rectum, anus, rectosigmoid	0	0.04				
Liver	~	0.49				
Pancreas	0	0.03				
Larynx	0	0.00				
Trachea, bronchus, lung, pleura	0	0.36				
Bones and Joints	~	1.54				
Soft Tissue including Heart	~	1.90				
Melanoma of the Skin	0	0.65				
Female Breast	0	0.02				
Cervix Uteri	0	0.06				
Corpus Uteri	0	0.02				
Ovary	0	0.49				
Prostate	0	0.06				
Testis	0	0.56				
Urinary Bladder	0	0.09				
Kidney and Renal Pelvis	~	1.37				
Renal pelvis	0	0.00				
Brain and other nervous system	7	6.47	1.08	0.43	2.23	
Thyroid	0	0.86				
Hodgkin disease	~	1.81				
Non-Hodgkin Lymphoma	0	2.03				
Multiple Myeloma	0	0.00				
Leukemia	8	7.68	1.04	0.45	2.05	
Other	~	2.80				
Gallbladder	0	0.01				
Male breast	0	0.00				
Intrahepatic bile duct	0	0.00				
Other including bone, liver, soft tissue	7	6.74	1.04	0.42	2.14	
Total	28	29.92	0.94	0.62	1.35	

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Numbers <6 are suppressed to protect the confidentiality of cancer patients.

Table B2. Number of observed and expected incident cases of cancers among children age 17 or younger in ZIP code 63033, 1996-2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	0	0.69				
Pharynx (naso-, oro-, & hypo-)	0	0.42				
Salivary gland	0	0.18				
Esophagus	0	0.00				
Stomach	0	0.07				
Colon	0	0.06				
Appendix	0	0.01				
Rectum, anus, rectosigmoid	0	0.08				
Liver	0	0.43				
Pancreas	0	0.03				
Larynx	0	0.00				
Trachea, bronchus, lung, pleura	0	0.28				
Bones and Joints	~	1.42				
Soft Tissue including Heart	~	1.58				
Melanoma of the Skin	0	0.40				
Female Breast	0	0.04				
Cervix Uteri	0	0.08				
Corpus Uteri	0	0.01				
Ovary	0	0.51				
Prostate	0	0.02				
Testis	0	0.30				
Urinary Bladder	0	0.04				
Kidney and Renal Pelvis	~	1.36				
Renal pelvis	0	0.00				
Brain and other nervous system	~	4.62				
Thyroid	0	0.59				
Hodgkin disease	~	1.60				
Non-Hodgkin Lymphoma	~	1.63				
Multiple Myeloma	0	0.00				
Leukemia	6	6.13				
Other	~	2.66	0.38	0.00	2.09	
Gallbladder	0	0.00				
Male breast	0	0.00				
Intrahepatic bile duct	0	0.00				
Other including bone, liver, soft tissue	~	6.09				
Total	18	24.64	0.73	0.43	1.15	

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Numbers <6 are suppressed to protect the confidentiality of cancer patients.

Table B3. Number of observed and expected incident cases of cancers among children age 17 or younger in ZIP code 63034, 1996-2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	0	0.24				
Pharynx (naso-, oro-, & hypo-)	0	0.14				
Salivary gland	0	0.06				
Esophagus	0	0.00				
Stomach	0	0.03				
Colon	0	0.03				
Appendix	0	0.01				
Rectum, anus, rectosigmoid	0	0.03				
Liver	0	0.15				
Pancreas	0	0.01				
Larynx	0	0.00				
Trachea, bronchus, lung, pleura	0	0.10				
Bones and Joints	~	0.59				
Soft Tissue including Heart	~	0.61				
Melanoma of the Skin	0	0.19				
Female Breast	0	0.01				
Cervix Uteri	0	0.03				
Corpus Uteri	0	0.00				
Ovary	0	0.20				
Prostate	0	0.01				
Testis	0	0.17				
Urinary Bladder	0	0.02				
Kidney and Renal Pelvis	~	0.43				
Renal pelvis	0	0.00				
Brain and other nervous system	0	1.90				
Thyroid	~	0.28				
Hodgkin disease	0	0.69				
Non-Hodgkin Lymphoma	~	0.68				
Multiple Myeloma	0	0.00				
Leukemia	~	2.32				
Other	0	0.91				
Gallbladder	0	0.00				
Male breast	0	0.00				
Intrahepatic bile duct	0	0.00				
Other including bone, liver, soft tissue	~	2.26				
Total	8	9.63	0.83	0.36	1.64	

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Numbers <6 are suppressed to protect the confidentiality of cancer patients.

Table B4. Number of observed and expected incident cases of cancers among children age 17 or younger in ZIP code 63042, 1996-2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	0	0.18				
Pharynx (naso-, oro-, & hypo-)	0	0.10				
Salivary gland	0	0.05				
Esophagus	0	0.00				
Stomach	0	0.02				
Colon	0	0.03				
Appendix	0	0.01				
Rectum, anus, rectosigmoid	0	0.02				
Liver	0	0.18				
Pancreas	0	0.01				
Larynx	0	0.00				
Trachea, bronchus, lung, pleura	0	0.13				
Bones and Joints	0	0.53				
Soft Tissue including Heart	0	0.66				
Melanoma of the Skin	0	0.21				
Female Breast	0	0.01				
Cervix Uteri	0	0.02				
Corpus Uteri	0	0.00				
Ovary	~	0.17				
Prostate	0	0.02				
Testis	0	0.17				
Urinary Bladder	0	0.03				
Kidney and Renal Pelvis	0	0.53				
Renal pelvis	0	0.00				
Brain and other nervous system	~	2.17				
Thyroid	0	0.27				
Hodgkin disease	0	0.63				
Non-Hodgkin Lymphoma	~	0.68				
Multiple Myeloma	0	0.00				
Leukemia	~	2.67				
Other	0	1.04				
Gallbladder	0	0.00				
Male breast	0	0.00				
Intrahepatic bile duct	0	0.00				
Other including bone, liver, soft tissue	0	2.41				
Total	9	10.38	0.87	0.40	1.65	

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Numbers <6 are suppressed to protect the confidentiality of cancer patients.

Table B5. Number of observed and expected incident cases of cancers among children 17 or younger in ZIP code 63043, 1996-2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	0	0.13				
Pharynx (naso-, oro-, & hypo-)	0	0.06				
Salivary gland	0	0.04				
Esophagus	0	0.00				
Stomach	0	0.01				
Colon	0	0.03				
Appendix	0	0.01				
Rectum, anus, rectosigmoid	0	0.01				
Liver	~	0.19				
Pancreas	0	0.02				
Larynx	0	0.00				
Trachea, bronchus, lung, pleura	0	0.13				
Bones and Joints	0	0.57				
Soft Tissue including Heart	~	0.75				
Melanoma of the Skin	~	0.25				
Female Breast	~	0.01				
Cervix Uteri	0	0.02				
Corpus Uteri	0	0.01				
Ovary	0	0.16				
Prostate	0	0.02				
Testis	0	0.23				
Urinary Bladder	0	0.04				
Kidney and Renal Pelvis	~	0.50				
Renal pelvis	0	0.00				
Brain and other nervous system	7	2.54	2.76	1.10	5.68	SH
Thyroid	0	0.32				
Hodgkin disease	~	0.67				
Non-Hodgkin Lymphoma	~	0.76				
Multiple Myeloma	0	0.00				
Leukemia	~	3.04				
Other	0	1.05				
Gallbladder	0	0.00				
Male breast	0	0.00				
Intrahepatic bile duct	0	0.00				
Other including bone, liver, soft tissue	~	2.56				
Total	18	11.44	1.57	0.93	2.49	

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Numbers <6 are suppressed to protect the confidentiality of cancer patients.

Table B6. Number of observed and expected incident cases of cancers among children age 17 or younger in ZIP code 63044, 1996-2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	0	0.09				
Pharynx (naso-, oro-, & hypo-)	0	0.04				
Salivary gland	0	0.03				
Esophagus	0	0.00				
Stomach	0	0.01				
Colon	0	0.02				
Appendix	0	0.01				
Rectum, anus, rectosigmoid	0	0.01				
Liver	0	0.10				
Pancreas	0	0.01				
Larynx	0	0.00				
Trachea, bronchus, lung, pleura	0	0.07				
Bones and Joints	0	0.36				
Soft Tissue including Heart	0	0.41				
Melanoma of the Skin	0	0.15				
Female Breast	0	0.00				
Cervix Uteri	0	0.01				
Corpus Uteri	0	0.00				
Ovary	0	0.11				
Prostate	0	0.01				
Testis	0	0.14				
Urinary Bladder	0	0.02				
Kidney and Renal Pelvis	0	0.28				
Renal pelvis	0	0.00				
Brain and other nervous system	0	1.44				
Thyroid	0	0.21				
Hodgkin disease	0	0.43				
Non-Hodgkin Lymphoma	~	0.46				
Multiple Myeloma	0	0.00				
Leukemia	~	1.66				
Other	~	0.58				
Gallbladder	0	0.00				
Male breast	0	0.00				
Intrahepatic bile duct	0	0.00				
Other including bone, liver, soft tissue	~	1.45				
Total	~	6.60				

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Numbers <6 are suppressed to protect the confidentiality of cancer patients.

Table B7. Number of observed and expected incident cases of cancers among children age 17 or younger in ZIP code 63134, 1996-2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	0	0.29				
Pharynx (naso-, oro-, & hypo-)	0	0.19				
Salivary gland	0	0.07				
Esophagus	0	0.00				
Stomach	0	0.03				
Colon	0	0.02				
Appendix	0	0.00				
Rectum, anus, rectosigmoid	0	0.03				
Liver	0	0.17				
Pancreas	0	0.01				
Larynx	0	0.00				
Trachea, bronchus, lung, pleura	0	0.10				
Bones and Joints	~	0.53				
Soft Tissue including Heart	~	0.61				
Melanoma of the Skin	0	0.13				
Female Breast	0	0.02				
Cervix Uteri	0	0.04				
Corpus Uteri	0	0.00				
Ovary	0	0.20				
Prostate	0	0.01				
Testis	0	0.07				
Urinary Bladder	0	0.01				
Kidney and Renal Pelvis	~	0.56				
Renal pelvis	0	0.00				
Brain and other nervous system	~	1.70				
Thyroid	0	0.19				
Hodgkin disease	0	0.58				
Non-Hodgkin Lymphoma	~	0.59				
Multiple Myeloma	0	0.00				
Leukemia	~	2.36				
Other	~	1.07				
Gallbladder	0	0.00				
Male breast	0	0.00				
Intrahepatic bile duct	0	0.00				
Other including bone, liver, soft tissue	~	2.39				
Total	11	9.33	1.18	0.59	2.11	

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Numbers <6 are suppressed to protect the confidentiality of cancer patients.

Table B8. Number of observed and expected incident cases of cancers among children age 17 or younger in ZIP code 63138, 1996-2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	0	0.42				
Pharynx (nasal, oral, & hypopharyngeal)	0	0.26				
Salivary gland	0	0.11				
Esophagus	0	0.00				
Stomach	0	0.05				
Colon	0	0.03				
Appendix	0	0.00				
Rectum, anus, rectosigmoid	0	0.05				
Liver	~	0.25				
Pancreas	0	0.01				
Larynx	0	0.00				
Trachea, bronchus, lung, pleura	0	0.16				
Bones and Joints	~	0.76				
Soft Tissue including Heart	0	0.89				
Melanoma of the Skin	0	0.19				
Female Breast	0	0.02				
Cervix Uteri	0	0.05				
Corpus Uteri	0	0.00				
Ovary	0	0.27				
Prostate	0	0.01				
Testis	~	0.12				
Urinary Bladder	0	0.01				
Kidney and Renal Pelvis	~	0.96				
Renal pelvis	0	0.00				
Brain and other nervous system	~	2.49				
Thyroid	0	0.29				
Hodgkin disease	~	0.85				
Non-Hodgkin Lymphoma	~	0.86				
Multiple Myeloma	0	0.00				
Leukemia	~	3.50				
Other	~	1.68				
Gallbladder	0	0.00				
Male breast	0	0.00				
Intrahepatic bile duct	0	0.00				
Other including bone, liver, soft tissue	~	3.57				
Total	15	13.92	1.08	0.60	1.78	

*Expected based on the rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Numbers <6 are suppressed to protect the confidentiality of cancer patients.

Table B9. Number of observed and expected incident cases of cancers among children age 17 or younger in 8 ZIP codes combined, 1996-2011

Site	Observed cases	Expected cases*	SIR	Lower 95% CL	Upper 95% CL	Sig
Oral Cavity and Pharynx	~	2.48				
Pharynx (naso-, oro-, & hypo-)	0	1.45				
Salivary gland	~	0.68				
Esophagus	0	0.00				
Stomach	0	0.28				
Colon	0	0.30				
Appendix	0	0.07				
Rectum, anus, rectosigmoid	0	0.27				
Liver	~	1.96				
Pancreas	0	0.14				
Larynx	0	0.00				
Trachea, bronchus, lung, pleura	0	1.35				
Bones and Joints	7	6.30	1.11	0.44	2.29	
Soft Tissue including Heart	9	7.41	1.21	0.55	2.31	
Melanoma of the Skin	~	2.16				
Female Breast	~	0.13				
Cervix Uteri	0	0.31				
Corpus Uteri	0	0.05				
Ovary	~	2.10				
Prostate	0	0.16				
Testis	~	1.78				
Urinary Bladder	0	0.26				
Kidney and Renal Pelvis	7	5.98	1.17	0.47	2.41	
Renal pelvis	0	0.00				
Brain and other nervous system	26	23.34	1.11	0.73	1.63	
Thyroid	~	3.01				
Hodgkin disease	6	7.26	0.83	0.30	1.80	
Non-Hodgkin Lymphoma	10	7.69	1.30	0.62	2.39	
Multiple Myeloma	0	0.00				
Leukemia	30	29.36	1.02	0.69	1.46	
Other	6	11.80	0.51	0.19	1.11	
Gallbladder	0	0.03				
Male breast	0	0.00				
Intrahepatic bile duct	0	0.00				
Other including bone, liver, soft tissue	25	27.47	0.91	0.59	1.34	
Total	111	115.87	0.96	0.79	1.15	

The rates for the rest of the state (excluding the 8 ZIP code area included in this study). SIR: Standardized incidence ratio. CL: Confidence Limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. ~ Numbers <6 are suppressed to protect the confidentiality of cancer patients.

Table C1. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, ZIP Code 63031, Missouri, 1996-2011

Age	Female						Male						Total					
	Obs.	Exp.	SIR	LCL	UCL	Sig.	Obs.	Exp.	SIR	LCL	UCL	Sig.	Obs.	Exp.	SIR	LCL	UCL	Sig.
0-14	~	3.08	1.62	0.52	3.79	No	~	3.77	0.53	0.06	1.92	No	7	6.85	1.02	0.41	2.11	No
15-44	~	4.60	0.65	0.13	1.91	No	8	5.95	1.34	0.58	2.65	No	11	10.55	1.04	0.52	1.87	No
45-64	17	10.38	1.64	0.95	2.62	No	13	14.15	0.92	0.49	1.57	No	30	24.53	1.22	0.82	1.75	No
65+	22	28.97	0.76	0.48	1.15	No	47	31.48	1.49	1.10	1.99	SH	69	60.45	1.14	0.89	1.44	No
Total	47	47.02	1.00	0.73	1.33	No	70	55.35	1.26	0.99	1.60	No	117	102.37	1.14	0.95	1.37	No

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio. Sig: Significantly different between observed and expected cases. Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant different between the observed and the expected. ~Number <6 is suppressed to protect the confidentiality of cancer patients.

Table C2. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, Residents of Zip Code 63033, Missouri, 1996-2011

Age	Female							Male							Total						
	Obs.	Exp.	SIR	LCL	UCL	Sig.		Obs.	Exp.	SIR	LCL	UCL	Sig.		Obs.	Exp.	SIR	LCL	UCL	Sig.	
0-14	~	2.22	0.90	0.10	3.25	No		~	3.09	1.29	0.35	3.31	No		6	5.31	1.13	0.41	2.46	No	
15-44	~	4.05	0.99	0.27	2.53	No		~	5.31	0.75	0.20	1.93	No		8	9.36	0.85	0.37	1.68	No	
45-64	12	10.1	1.19	0.61	2.08	No		19	13.11	1.45	0.87	2.26	No		31	23.21	1.34	0.91	1.90	No	
65+	34	28.73	1.18	0.82	1.65	No		35	33.85	1.05	0.73	1.46	No		69	62.08	1.11	0.86	1.41	No	
Total	52	45.1	1.15	0.86	1.51	No		62	54.86	1.13	0.87	1.45	No		114	99.97	1.14	0.94	1.37	No	

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio. Sig: Significantly different between observed and expected cases. Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant different between the observed and the expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table C3. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, Residents of Zip Code 63034, Missouri, 1996-2011

Age	Female					Male					Total				
	Obs.	Exp.	SIR	LCL	UCL	Sig.	Obs.	Exp.	SIR	LCL	UCL	Sig.	Obs.	Exp.	SIR
0-14	~	0.85	1.18	0.02	6.55	No	~	1.1	0.91	0.01	5.06	No	~	1.95	1.03
15-44	~	1.48	0.68	0.01	3.76	No	0	1.93	0.00	0.00	0.00	No	~	3.41	0.29
45-64	6	4.58	1.31	0.48	2.85	No	~	6.83	0.73	0.24	1.71	No	11	11.41	0.96
65+	7	7.24	0.97	0.39	1.99	No	10	10.32	0.97	0.46	1.78	No	17	17.56	0.97
Total	15	14.16	1.06	0.59	1.75	No	16	20.18	0.79	0.45	1.29	No	31	34.34	0.90

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio: Sig: Significantly different between observed and expected cases. Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant different between the observed and the expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table C4. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, Residents of Zip Code 63042, Missouri, 1996-2011

Age	Female					Male					Total				
	Obs.	Exp.	SIR	LCL	UCL	Sig.	Obs.	Exp.	SIR	LCL	UCL	Sig.	Obs.	Exp.	SIR
0-14	~	1.03	1.94	0.22	7.01	No	~	1.36	0.74	0.01	4.09	No	~	2.38	1.26
15-44	~	1.24	1.03	0.12	3.72	No	~	2.54	0.79	0.09	2.84	No	~	4.48	0.89
45-64	~	4.03	1.24	0.40	2.90	No	6	5.43	1.10	0.40	2.41	No	11	9.46	1.16
65+	~	9.16	0.55	0.18	1.27	No	13	10.61	1.23	0.65	2.10	No	18	19.77	0.91
Total	14	16.16	0.87	0.47	1.45	No	22	19.93	1.10	0.69	1.67	No	36	36.09	1.00

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio: Sig: Significantly different between observed and expected cases. Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant different between the observed and the expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table C5. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, Residents of Zip Code 63043, Missouri, 1996-2011

Age	Female						Male						Total					
	Obs	Exp	SIR	LCL	UCL	Sig	Obs	Exp	SIR	LCL	UCL	Sig	Obs	Exp	SIR	LCL	UCL	Sig
0-14	~	1.24	1.61	0.18	5.82	No	~	1.51	0.66	0.01	3.68	No	~	2.75	1.09	0.22	3.19	No
15-44	~	2.21	0.45	0.01	2.52	No	~	2.85	0.70	0.08	2.53	No	~	5.06	0.59	0.12	1.73	No
45-64	9	4.97	1.81	0.83	3.44	No	8	6.83	1.17	0.50	2.31	No	17	11.8	1.44	0.84	2.31	No
65+	14	10.31	1.36	0.74	2.28	No	17	12.19	1.39	0.81	2.23	No	31	22.5	1.38	0.94	1.96	No
Total	26	18.72	1.39	0.91	2.04	No	28	23.38	1.20	0.80	1.73	No	54	42.1	1.28	0.96	1.67	No

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio. Sig: Significantly different between observed and expected cases. Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant different between the observed and the expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table C6. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, Residents of Zip Code 63044, Missouri, 1996-2011

Age	Female						Male						Total					
	Obs.	Exp.	SIR	LCL	UCL	Sig.	Obs.	Exp.	SIR	LCL	UCL	Sig.	Obs.	Exp.	SIR	LCL	UCL	Sig.
0-14	0	0.63	0.00	0.00	0.00	No	~	0.82	2.44	0.27	8.81	No	~	1.46	1.37	0.15	4.95	No
15-44	~	1.07	0.93	0.01	5.20	No	~	1.43	1.40	0.16	5.05	No	~	2.5	1.20	0.24	3.51	No
45-64	~	3.29	1.22	0.33	3.11	No	~	4.69	0.64	0.13	1.87	No	7	7.99	0.88	0.35	1.81	No
65+	15	10.22	1.47	0.82	2.42	No	10	10.68	0.94	0.45	1.72	No	25	20.9	1.20	0.77	1.77	No
Total	20	15.23	1.31	0.80	2.03	No	17	17.62	0.96	0.56	1.54	No	37	32.85	1.13	0.79	1.55	No

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio. Sig: Significantly different between observed and expected cases. Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant different between the observed and the expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table C7. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, Residents of Zip Code 63134, Missouri, 1996-2011

Age	Female							Male							Total					
	Obs.	Exp.	SIR	LCL	UCL	Sig		Obs.	Exp.	SIR	LCL	UCL	Sig		Obs.	Exp.	SIR	LCL	UCL	Sig
0-14	~	0.89	2.25	0.25	8.11	No		~	1.19	0.84	0.01	4.68	No		~	2.08	1.44	0.29	4.21	No
15-44	~	1.41	2.84	0.76	7.26	No		~	1.77	1.69	0.34	4.95	No		7	3.18	2.20	0.88	4.54	No
45-64	~	2.87	0.70	0.08	2.52	No		~	3.57	0.84	0.17	2.46	No		~	6.43	0.78	0.25	1.81	No
65+	~	6.28	0.80	0.26	1.86	No		8	7.47	1.07	0.46	2.11	No		13	13.75	0.95	0.50	1.62	No
Total	13	11.45	1.14	0.60	1.94	No		15	13.99	1.07	0.60	1.77	No		28	25.44	1.10	0.73	1.59	No

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio. Sig: Significantly different between observed and expected cases. Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant different between the observed and the expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table C8. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, Residents of Zip Codes 63138, Missouri, 1996-2011

Age	Female						Male						Total					
	Obs.	Exp.	SIR	LCL	UCL	Sig.	Obs.	Exp.	SIR	LCL	UCL	Sig.	Obs.	Exp.	SIR	LCL	UCL	Sig.
0-14	0	1.28	0.00	0.00	0.00	No	~	1.81	1.10	0.12	3.99	No	~	3.08	0.65	0.07	2.34	No
15-44	~	2.18	0.46	0.01	2.55	No	0	2.71	0.00	0.00	0.00	No	~	4.89	0.20	0.00	1.14	No
45-64	~	3.73	1.07	0.29	2.75	No	7	5.01	1.40	0.56	2.88	No	11	8.74	1.26	0.63	2.25	No
65+	10	9.51	1.18	0.59	2.11	No	13	11.44	1.14	0.60	1.94	No	24	20.75	1.16	0.74	1.72	No
Total	16	16.5	0.97	0.55	1.57	No	22	20.97	1.05	0.66	1.59	No	38	37.47	1.01	0.72	1.39	No

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio. Sig: Significantly different between observed and expected cases. Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant different between the observed and the expected. ~ Number <6 is suppressed to protect the confidentiality of cancer patients.

Table C9. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, Residents of all 8 Zip Codes Combined, Missouri, 1996-2011

Age	Female					Male					Total				
	Obs	Exp	SIR	LCL	UCL	Sig	Obs	Exp	SIR	LCL	UCL	Sig	Obs	Exp	Sig
0-14	14	11.22	1.25	0.68	2.09	No	14	14.64	0.96	0.52	1.60	No	28	25.87	No
15-44	17	18.94	0.90	0.52	1.44	No	21	24.49	0.86	0.53	1.31	No	38	43.43	No
45-64	59	43.94	1.34	1.02	1.73	SH	64	59.63	1.07	0.83	1.37	No	123	103.57	No
65+	113	110.23	1.03	0.84	1.23	No	153	127.53	1.20	1.02	1.41	SH	266	237.75	No
Total	203	184.34	1.10	0.95	1.26	No	252	226.29	1.11	0.98	1.26	No	455	410.62	SH

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio. Sig: Significantly different between observed and expected cases. Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant different between the observed and the expected.

Table D. Observed and expected incident cases of leukemia in selected ZIP codes by years, Missouri

ZIP Code	1996-2000						2001-2005						2006-2011					
	Obs.	Exp.	SIR	LCL	UCL	Sig.	Obs.	Exp.	SIR	LCL	UCL	Sig.	Obs.	Exp.	SIR	LCL	UCL	Sig.
63031	30	30.80	0.97	0.66	1.39	No	37	33.23	1.11	0.78	1.53	No	50	38.38	1.30	0.97	1.72	No
63033	31	31.58	0.98	0.67	1.39	No	34	32.24	1.05	0.73	1.47	No	49	36.52	1.34	0.99	1.77	No
63034	6	9.30	0.64	0.24	1.40	No	9	10.90	0.83	0.38	1.57	No	16	14.12	1.13	0.65	1.84	No
63042	10	10.61	0.94	0.45	1.73	No	12	11.67	1.03	0.53	1.80	No	14	13.79	1.02	0.55	1.70	No
63043	18	11.54	1.56	0.92	2.46	No	18	13.59	1.32	0.78	2.09	No	18	16.91	1.06	0.63	1.68	No
63044	15	10.77	1.39	0.78	2.30	No	6	10.79	0.56	0.20	1.21	No	16	11.35	1.41	0.81	2.29	No
63134	11	8.47	1.30	0.65	2.32	No	10	8.15	1.23	0.59	2.26	No	7	8.93	0.78	0.31	1.62	No
63138	17	12.37	1.37	0.80	2.20	No	9	12.10	0.74	0.34	1.41	No	12	13.07	0.92	0.47	1.60	No
Combined	138	125.44	1.10	0.92	1.30	No	135	132.67	1.02	0.85	1.20	No	182	153.05	1.19	1.02	1.38	SH

LCL: Lower 95% confidence limit. UCL: Upper 95% confidence limit. Sig: Significantly different between observed and expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant difference between the observed and the expected.

Table E1. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, ZIP Code 63031, Missouri, 1996-2005

Age	Female			Male			Total
0-14	~	1.82	2.20	0.59	5.63	No	~ 2.57 0.39 0.01 2.16 No 4.39 1.14 0.37 2.66 No
45-64	13	5.99	2.17	1.15	3.71	SH	7 8.25 0.85 0.34 1.75 No 20 14.24 1.40 0.86 2.17 No
Total	29	29.26	0.99	0.66	1.42	No	38 34.72 1.09 0.77 1.50 No 67 63.98 1.05 0.81 1.33 No

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio: Sig: Significantly different between observed and expected cases.
 Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant difference between the observed and the expected. ~ Number <6 suppressed to protect the confidentiality of cancer patients

Table E2. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, ZIP Code 63031, Missouri, 2006-2011

Age	Female			Male			Total
0-14	~	1.26	0.79	0.01	4.42	No	~ 1.20 0.84 0.01 4.65 No 2.46 0.81 0.09 2.94 No
45-64	~	4.39	0.91	0.24	2.33	No	6 5.90 1.02 0.37 2.21 No 10 10.29 0.97 0.47 1.79 No
Total	18	17.76	1.01	0.60	1.60	No	32 20.63 1.55 1.06 2.19 SH 50 38.38 1.30 0.97 1.72 No

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio: Sig: Significantly different between observed and expected cases.
 Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant difference between the observed and the expected. ~ Number <6 suppressed to protect the confidentiality of cancer patients

Table E3. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, ZIP Code 63033, Missouri, 2006-2011

Age	Female			Male			Total
0-14	0	0.75	0.00	--	--	No	~ 0.98 2.04 0.23 7.36 No 1.73 1.16 0.13 4.17 No
15-44	~	1.15	1.74	0.20	6.27	No	~ 1.70 1.76 0.35 5.15 No 2.85 1.75 0.56 4.09 No
45-64	~	4.43	0.90	0.24	2.31	No	11 4.85 2.27 1.13 4.06 SH 15 9.28 1.62 0.90 2.67 No
Total	20	16.98	1.18	0.72	1.82	No	29 19.54 1.48 0.99 2.13 No 49 36.52 1.34 0.99 1.77 No

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio: Sig: Significantly different between observed and expected cases.
 Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant difference between the observed and the expected. ~ Number <6 suppressed to protect the confidentiality of cancer patients

Table E4. Observed and Expected Numbers of Incident Cases of Leukemia by Age and Gender, ZIP Codes 63031 & 63033, Missouri, 2006-2011

Age	Female			Male			Total		
	Obs	Exp	Ratio	Obs	Exp	Ratio	Obs	Exp	Ratio
0-14	~	2.01	0.50	0.01	2.77	No	~	4.19	0.96
15-44	~	2.62	1.91	0.61	4.45	No	~	6.92	1.58
45-64	8	8.82	0.91	0.39	1.79	No	25	19.57	1.28
65+	24	21.28	1.13	0.72	1.68	No	60	44.82	1.34
Total	38	34.73	1.09	0.77	1.50	No	99	74.90	1.32

LCL: lower 95% confidence limit. UCL: Upper 95% confidence limit. SIR: Standardized incidence ratio: Sig: Significantly different between observed and expected cases.

Obs: Observed cases Exp: Expected cases. SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant difference between the observed and the expected. ~ Number <6 suppressed to protect the confidentiality of cancer patients

Table F. Observed and expected incident cases of leukemia in selected ZIP codes, Missouri, 1996-2011

Compared to the Rest of the State							Compared to the Rest of St. Louis County					Compared to the US				
63031	117	102.37	1.14	0.95	1.37	No	111.71	1.05	0.87	1.26	No	112.17	1.04	0.86	1.25	No
63033	114	99.97	1.14	0.94	1.37	No	108.29	1.05	0.87	1.26	No	105.23	1.08	0.89	1.30	No
63034	31	34.34	0.90	0.61	1.28	No	37.23	0.83	0.57	1.18	No	36.32	0.85	0.58	1.21	No
63042	36	36.09	1.00	0.70	1.38	No	39.21	0.92	0.64	1.27	No	39.26	0.92	0.64	1.27	No
63043	54	42.10	1.28	0.96	1.67	No	46.25	1.17	0.88	1.52	No	46.63	1.16	0.87	1.51	No
63044	37	32.85	1.13	0.79	1.55	No	35.91	1.03	0.75	1.42	No	36.20	1.02	0.72	1.41	No
63134	28	25.44	1.10	0.73	1.59	No	27.38	1.02	0.68	1.48	No	26.16	1.07	0.71	1.55	No
63138	38	37.47	1.01	0.72	1.39	No	39.62	0.96	0.68	1.32	No	38.75	0.98	0.69	1.35	No
Combined	455	410.62	1.11	1.01	1.21	SH	445.59	1.02	0.95	1.12	No	440.72	1.03	0.94	1.13	No

Table F continued

Compared to Jackson County							Compared to St. Louis County				
63031	117	100.52	1.16	0.96	1.39	No	92.33	1.27	1.05	1.52	SH
63034	31	38.88	0.92	0.62	1.30	No	31.30	0.99	0.67	1.41	No
63042	36	35.40	1.02	0.71	1.41	No	32.84	1.10	0.77	1.52	No
63043	54	41.58	1.30	0.98	1.69	No	37.52	1.44	1.08	1.88	SH
63044	37	32.27	1.15	0.81	1.58	No	29.45	1.26	0.88	1.73	No
63134	28	24.97	1.12	0.74	1.62	No	24.00	1.17	0.77	1.69	SH
63138	38	36.80	1.03	0.73	1.42	No	35.49	1.07	0.76	1.47	No
Combined	455	403.19	1.13	1.03	1.24	SH	376.32	1.21	1.10	1.33	SH

Obs: Number of observed cases

Exp1: Number of Expected cases based on the rate for the rest of the state. Exp2: Expected based on the rate for the rest of St. Louis County. Exp3: Expected based on the rate from the Surveillance, Epidemiology and End Results (SEER) Program. Exp4: Expected based on the rate for Jackson County. Exp5: Expected based on the rate for St. Louis City.

LCL: Lower 95% confidence limits. UCL: Upper 95% confidence limits. Sig: Significantly different between observed and expected cases.

SH: Observed is significantly higher than expected. SL: Observed is significantly lower than expected. No: No significant difference between the observed and the expected.

When combined ZIP codes 63031, 63033, & 63043, the number of observed was not significantly different from that expected based on the rest of St. Louis or SEER. Neither was when only ZIP codes 63031 & 63033 were combined